Project Management, Finance and Risk: Projects Offered

[MQ1] Project management in medical device New Product Development (NPD): Effective and efficient project management is an important function of successful medical device product development. For companies of all sizes, the results of inadequate project management can be devastating, causing delays and financial losses. Better understanding of the development process, as well as the phases and regulations, project managers can plan and execute more effectively. This project will explore the various project management tools and techniques and advice on which of these is recommended in the field of medical device NPD.

[MQ2] Financial analysis of implementing technology-supported self-management in healthcare: Technological advances offer significant opportunities to improve healthcare and deliver large savings for the NHS, but initial implementation costs are high especially under the current financial pressures facing the NHS. Of the various technologies available today, self-management tools such as online health communities and smart watches that can monitor heart rate, blood oxygen levels can empower patients to better manage and understand their conditions and improve clinical outcomes. This project will explore the financial implications for integration of technology-supported self-management into healthcare practice and analyse the potential financial gains/losses.

[JM1] Managing risk of failure of new medical devices: Commercial medical devices are amongst the most heavily regulated devices in the world. Regardless of their function, the end user (doctor, nurse, surgeon, healthcare worker) must have absolute confidence in the device's ability to perform its' primary task. Whether the device is a patient warmer for surgery, a ventilator used in anaesthesia or an implantable pacemaker, the manufacturing and quality assurance controls of the device must be robust enough to mitigate the fallout if such devices fail as a result of manufacturing faults or user error. This project will explore the different safe-measures in place that medical device manufacturers must follow in order to comply with UK, EU and US law.

[JM2] Financial and risk assessment of clinical trials: Medical devices, drugs, and therapies & treatment regimens undergo intense scrutiny before they are brought to the health care sector. One of the control mechanisms in place is a process of ethical approvals related to the clinical trials of said device, drug or treatment. This project will explore the process of ethical approvals needed for each type of clinical trial (device, drug, therapies and treatments) and make comparisons between each in terms of overall estimated cost, and risk factor.

[**RM1]** Pick a company and then you can analyse their risk management protocol or how they keep their business safe from high risk behaviour.

[RM2] Identity and measure the risk that the UK government took when they bailed out all of those banks that were on the verge of bankruptcy in the late 2000s.

[RM3] How can the stock market be used to make risk free profits, over the long term overcoming the Brexit impact?

[RM4] Health-conscious multi-purpose work space: The development of an initial idea to the business model.

[RM5] Fun@Holy: Holiday app for families to socialise with likeminded tourists: from ideation to business model.

[BRE1] Prioritisation of different categories of social responsibility within organisations: Decisions taken by engineers impact the world, it is increasingly important that engineers have the tools and knowledge to be socially responsible professionals. This project aims to investigate how organisations prioritise social responsibility and decide which the areas of social responsibility they focus on and which to not. Companies prioritisation will differ it will be important to consider the support system used to make decisions. This will contribute to a larger project for developing a measurement framework for assessing organisations social responsibility.

[BRE2] Developing measures of social responsibility focusing on organisations' risk management: Decisions taken by engineers impact the world, it is increasingly important that engineers have the tools and knowledge to be socially responsible professionals. This project focusses on how awareness of risks affects the social responsibility measures taken by the organisation.

[BRE3] Developing measures of social responsibility focusing on organisations' sustainability and economic circularity: Decisions taken by engineers impact the world, it is increasingly important that engineers have the tools and knowledge to be socially responsible professionals. This project aims to investigate how sustainability and circular economy is reflected in the social responsibility of organisation and the values associated with it. This will be used to develop a measurement framework for assessing dedication to sustainable as part of social responsibility.

[BRE4] Developing measures of social responsibility focusing on organisations' ethics: Decisions taken by engineers impact the world, it is increasingly important that engineers have the tools and knowledge to be socially responsible professionals. This project aims to investigate ethical values organisations are pursuing as part of their social responsibility. This

will be used to develop a measurement framework for assessing organisation dedication to social responsibility regarding ethical values.

[BR5] Future application of self-engineering with drones: Self-engineering (SE) systems aim to respond to failures, damage or degradation and return any functions which have been lost. Two industries where drones have been used for SE include 1) in wind turbines to observe damage to blades and even deposit repair robots, and 2) in the design of automated pothole repair. In the future, many other SE systems could utilise drones; this project aims to investigate this further. The aim is to identify and evaluate new industry application for drones in SE systems; this could be done through literature review or industry interviews. Basic cost estimations on the expense and benefits of using drones for SE could be conducted to identify the best options to pursue further. We expect to have an industry partner (TBC) working with us on this.

[VR1,2] Simulation analysis of public transport systems (2 students): In this project you will use simulation to analyse the performance of a public transport system of your choice (train, city bus system, motorways). You will use mathematical models to generate transport profiles and develop simple simulation programs to analyse the congestion, to dimension the transport network and identify risks. This project would be suitable to those students interested in data analysis. No significant experience in computer programming required.

[VR3] Optimisation of demand management in smart energy networks: In this project, you will understand the process of modelling of home energy use. You will use government documents and research papers to develop a model of home energy network use and will apply optimisation algorithms to evaluate and understand better the benefits of demand management of the efficient operation of the future smart grid energy network.

[VR4] Pricing strategies for 5G networks: In this project, you will analyse different potential pricing strategies and algorithms for telecommunication network content for the future. 5G networks, increased use of video-on-demand internet content and increased automation of everyday life brings new challenges and opportunities for telecommunications and Internet providers. You will analyses different pricing strategies and develop models to compare benefits and disadvantages of pricing strategies.

[MB1] Modelling cooperation and conflict in society using game theory: Cooperation is a fundamental part of human societies. Whilst there can be long term benefits to mutual cooperation, there are often short term advantages to individuals who cheat. What circumstances best enables cooperation to thrive, and how do we prevent cheating? We use game theory to explore this question.

[MB2] The optimal selection of financial portfolios: When making an investment it is important to get a good return, but at the same time minimise the risk. In the module Optimization and Decision Making we looked at a classical model of how to do this, based upon some specific assumptions. We shall consider the problem more generally, in a more realistic setting.

[MB3] The role of information in decision making: When making a decision it is important to have as much information about the situation as possible. How should we take into account an absence of certain keys pieces of information? What if our competitors possess more information than we do? We consider the effect of questions of information on what decisions should be made.

[DA1] Renewable resources integration to the grid: Renewable resources have integrated power systems in a large extent the past decades. However, renewable resources are highly variable and uncertain. Thus there is a need to model this uncertainty in power systems operation. In this project, the various ways of modelling uncertainty in power systems will be performed along with associated simulation studies. (Bessa, Ricardo & Moreira, C. & Silva, Bernardo & Matos, Manuel. (2014). Handling renewable energy variability and uncertainty in power systems operation. Wiley Interdisciplinary Reviews: Energy and Environment. 3. 10.1002/wene.76.)

[DA2] Electricity Markets in Distribution Systems: Over the past years, a great amount of distributed generation has been deployed in the grid. However, how the aforementioned generation sources interact with the bulk transmission system in a reliable and efficient way is not yet obvious. In this project, the development of an electricity market in the distribution system will be explored. The idea is that outcomes of this market will provide the appropriate incentives to the owners of distributed generation to offer services that are beneficial to the grid.

[DA3] Assessment of the Electric Vehicles Deployment on the Grid: The amount of electric vehicles (EVs) has increased due to various reasons. For instance, the 2008 Climate Change Act commits the UK to an emissions reduction target of 80% by 2050, and this has led the government to introduce grants to encourage people to purchase EVs. However, this deployment is likely to have an impact on the operation of the power grid. More specifically, this stands to increase the current peak power demanded from the grid. As well as the peak power, the amount of electricity required in a day by households will be larger. The quantification of these effects will be the goal of this project.

[IT1] Minimising investor risk when commercialising academic medical device protypes.

[AB1] The diffusion and adoption of innovations on social networks: How do innovations spread? Why is it the case that sometimes a sub-optimal innovation becomes the standard? This project examines these questions through multi-agent modelling.

[AB2] Contagion effects and information spreading in networked systems: How can we model information propagation on networks? Why do some items "go viral" while other don't? What is the difference between the spreading of a virus and the spreading of information? Many of questions like these are still open, but recent research is providing important insights. This project will analyse and compare different approaches and models.

[AB3] The dynamics of the cryptocurrency market: Cryptocurrencies have experienced a boom in 2017 and today there are more than 1,000 active cryptos. These project analyses the dynamics of the market by looking at data and through a modelling perspective.

[GH1] Portfolio optimisation with transaction costs: The aim of the project is to develop algorithms for optimally managing a portfolio of financial assets (e.g. bonds, shares and options) by striking a balance between expected growth and financial risk. Both one-period and multi-period models will be considered, along with various optimization methods (mean-variance, expected utility, VaR/CVaR, entropy). Imposing additional constraints related to transaction costs and portfolio rebalancing will also be considered. The project involves techniques based on statistics, optimisation and basic theory of finance.

[GH2] Modelling instability phenomena in Supply Chains - The bullwhip effect: The project will review the fundamental theory of supply chains and involves analytical, modelling and simulation work. The main aim is to develop an understanding of the “bullwhip-effect"; this is a dynamic instability phenomenon in supply chains related to increased volatility in order sizes and inventory levels at remote locations in the chain (away from generic customers). The effects of uncertain lead-times, rapid customer demand fluctuations and aggressive stock replenishment policies on the bullwhip effect will be analyzed. Part of the work will attempt to draw a formal parallel between this phenomenon and “string instabilities” arising in motorway traffic near a bottleneck.

[GH3] Network resource allocation via utility maximization: The project will investigate the application of network optimization algorithms for the fair allocation of divisible resources (e.g. network bandwidth) to competing agents. The algorithm will be distributed in nature and involves the maximization of an aggregate utility function subject to network capacity constraints. The fairness and scalability properties of the algorithm will be analyzed by considering both the primal and dual forms of the optimization problem. The project requires analytical, programming and simulation work.

[GH4] Contagion credit-risk models: The project will investigate contagion effects in a credit-risk model of portfolios of bonds where the default of one bond issuer either directly causes other parties to default or increases the risk of default (“Davis-Lo” infectious default model). The single-period model relies on a number on Bernoulli random variables which capture risk

correlation between bonds. This can be generalized to a multi-period model involving the evolution of a discrete Markov chain with a "hidden" state representing risk level. The project involves modelling work, parameter estimation of Hidden Markov Models (HMM), simulation work in Matlab and validation of the results using real default data.

[GH5] Development of Net Present Value (NPV) and Real-Options software tool with management decisions and uncertain parameters: The project will develop a software tool (proposed platform: Matlab) for project evaluation based on NPV analysis incorporating arbitrary cash-flow streams. Flexibility will be provided by modelling uncertain parameters as random variables and considering managerial decisions taken at different stages of the project's lifecycle. The software tool should generate a short report which includes relevant metrics and their statistical distribution (NPV, IRR, VaR, CVaR, sensitivity data, etc). This can be used by project managers to facilitate decision-making, e.g. project expansion, contraction, early termination, etc. Relations of the method with the theory of real options will also be investigated.

[GH6] Credit scoring via Machine Learning: Credit scoring is a fundamental problem faced by banks and financial institutions on an everyday basis. The project will review and implement in simulation environment (Matlab) several credit scoring methods based on Machine Learning, including logistic regression, decision trees and clustering methods. The project requires a basic understanding of Credit Scoring and Statistical, Optimisation and Machine learning models.

[DS1+DS2] Supply Chain and Climate Change Approach (Approach 1 & 2): An emerging requirement for supply chain management is for an impact assessment on climate change. This requirement ranges from sourced raw materials, processing and production, and transport (logistics) in world-wide settings. Specifically, this project will examine ways of being able to cost the impact on supply chain scenarios to identify least cost options. This project will be undertaken in liaison with a commercial company that markets a specific supply chain management solution that currently does not specifically focus on climate chain aspects. Two students can undertake this project, but the studies must be independent. The two projects will be carried out by two students working **independently.**

[DS3] Risk assessment on a Complex Supply Chain: Often a procurement is recorded in a project plan as a single activity even though this procurement can often represent a complex undertaking with many interrelated activities with difficult to determine timings. The result being that the project's overall risk can be driven by supply chain risk. This MSc project relates to examining a complex supply chain where a bespoke subassembly of a main project is being procured internationally with difficult technology readiness levels (TRLs) involved. The student will need to develop a test project plan for the procurement and examine risk assessment methods to best understand the overall procurement risk involved. The student should agree the procurement activity with the supervisor at an early stage. The MSc project will involve using software packages which will made available and described.

[DS4] Improved Supply Chain Quantitative Risk Assessment: The Supply Chain Module (EPM422) introduces two methods of supply chain risk assessment; 'Bow Tie' and 'Threshold'. This MSc project concerns the addition of quantification techniques to understand how both risk methods provide a better understanding of the risk involved in complex supply chains. This project provides the student with the opportunity of bringing together aspects from several modules of the course to address some of the real-life problems facing business today. Outputs from this MSc project could form the basis of a published paper.

[DS5] Review of the Queen Elizabeth Line Project in London: The Transport for London 'Queen Elizabeth Line (QEL)' Project is projected to be four to five years late with a cost estimated to be twice the cost stated at the approval stage. The QEL Project is currently the largest engineering infrastructure project in Europe. This MSc Project concerns a high-level assessment of the QEL Project. The student will be expected to provide: a high-level description of the QEL Project; a brief overview of its original business case; an analysis of the problems faced by the project (limit this to the three major problems – to be agreed with the supervision); actions that should/could have been undertaken by the QEL Project Management that would have mitigated or avoided the problems. All the information is available in the public domain, but an interview can be arranged, if required, with a senior QEL manager. This project will prepare students for work in a management consultancy.

[DS6] Improved Progress Assessment for projects: Earned Value is a key project progress assessment method and is widely used today. Another method for assessing progress is to use Milestone Charts. Both methods were addressed in EPM946. This MSc project is to devise a combination of the two methods to provided managers with a better understanding of progress. Using 'Schedule Variance (SV)' figures and Cost Variance (CV)' figures from the Earned Value method with a variation in the application with Milestone Charts could provide managers with an early warning of project problems. This MSc project is concerned with developing a working model of combined Earned Value and Milestone Chart methods to test this idea that could result in a published paper.

[DS7] Projects for Space Exploration: A project for space exploration has a specified launch date that is very difficult to delay. Specifically, a space mission usually has a specified orbit time that must be met, eg, for Voyager 1 and Voyager 2 the orbit required would not be met again for 7 years. Space projects are unique in that reduction in capability (requirement) is not normally an option that therefore crashing a project can only be achieved by doing the same things quicker! Space projects often use components that are barely TRL 9 (technology readiness level) and therefore carry addition risk. This MSc project is aimed at addressing specific risks faced by the space industry and identifying the options for managing them. This MSc project will suit a student who aims to gain employment with the fast-growing space industry.

[SHK1] Risk to the UK manufacturing industry from mid- to long-term disruption of overseas supply chains: The UK manufacturing sector remains strong and vibrant. It employs 2.7 million people contributing 11% of GVA, and accounts for 44% of UK's global exports (worth over £273 billion to the UK economy), 66% of UK R&D and 15% of the total business investment. It is the 9th largest manufacturer in the world by output. Like many other modern manufacturing sectors, the UK manufacturing sector relies upon many thousands of supply chain companies, both in the UK and overseas to deliver products, components, and specialised services. Consequently the manufacturing sector is sensitive to supply chain risks brought about by many factors including natural calamities, for example weather conditions, environmental impacts and epidemic/pandemic threats. This project will particularly focus on the risks to the UK manufacturing sector posed by the global outbreak of Covid-19 from the point of view of supply chain disruptions. It will also touch upon possible mitigation strategies.

[SHK2] Space elevator – concept, technology, financial viability and safety issues: Since the inception of the concept of space elevator by a Russian scientist, Konstantin Tsiolkovsky in 1895 the idea of a space elevator is still very much alive in our days. Today there is an International Space Elevator Consortium (ISEC), an affiliate with the National Space Society (US) which organises international conferences, workshops, etc. and liaises with similar bodies in Japan and Europe (Eurospaceward). A report published by the International Academy of Astronautics in 2019 concluded about the feasibility and near-future viability of such an elevator. The project will focus on the current state of the art in terms of underpinning science and technology, financial viability and safety issues associated with such an exciting mega project.

[SHK3] UK/Global Public health and financial impacts of an affordable non-invasive cholesterol measuring device: Regular monitoring of blood cholesterol level and lowering it, if needed by drugs and life-style changes can significantly lower the risk of cardiovascular and coronary heart diseases (CVDs and CHDs), especially for people at high-risk category. This is in the context of the fact that, according to WHO CVDs are the number 1 cause of death globally and an estimated 17.7 million people died from CVDs in 2015, representing 31% of all global deaths. In the UK CHD remains the number 1 killer. Cardiovascular (heart and circulatory) disease causes more than a quarter (26%) of all deaths in the UK (nearly 160,000 deaths each year). There is also potentially a significant impact on NHS and the UK economy in general in reducing costs associated with these diseases. The project will focus on the current technology for direct/indirect, non-invasive measurement of blood cholesterol and the financial aspects associated with the development of an affordable device both from the prospective of manufacturers and public health planners.

[KG1] Fibre Optic Sensor industry: Prospects and directions. The project will look at the technical and business directions of the industry and the prospects for the future.

[DN1] Project Management of the Implementation of a Renewable Energy Scheme

The implementation of a renewable energy scheme to generate electricity come not only with technical challenges, but with a wide range of non-technical concerns. These range from statutory requirements, to socio-economic factors, as well as financial risks. This project will involve an assessment of the project management side of implementing a renewable energy scheme of your choice (i.e. wind farm, solar PV plant, hydroelectric power), in a region of your choosing. You will be expected to assess the non-technical concerns of such a project, and derive a set of guidelines required to successfully being the project to fruition.

[DN2] Flying Taxi Start Up

In a bid to cut carbon emissions, electrically driven flying taxis are about to emerge around the world for use on short range trips from city centres to airports for example. This project will involve the study of the management, risks and financial factors involved in getting such a service off the ground. The project will culminate in the production of a set of non-technical guidelines required to launch a start-up company that would offer such a service.